REMARKS/ARGUMENTS

Request to Reconsider the Finality of the Office Action

If the Examiner is not prepared to allow the application, he is asked to reconsider and withdraw the finality of the office action.

Applicant submits that the finality of the office action should be withdrawn for the following reasons.

1. The rejection under 35 USC 103 is over US 3,798,333 (Cummin) "in view of applicant's admission of the prior art, further in view of... (eight references)". The same rejection was made in the previous office action on the merits, mailed 03/31/2004, and in the reply to that Office Action, Applicant noted

> *The Examiner has not specified what that alleged admission is, or where such admission is to be found. It is not possible, therefore, to carry out, either with regard to the alleged admission on its own or in combination with the other references, the actions mandated by MPEP 2141.... If the Examiner maintains any rejection which relies on an alleged admission by the Applicant, he is asked to specify what that admission is and where it is to be found.*

In the outstanding Office Action, the Examiner again relies on "applicant's admission of the prior art", and asserts, without further explanation,

> *The rejection appears to clearly state what applicants admission of the prior art is relied on to teach.*

At no point, however, in this or the previous Office Action, is there **any** statement, let alone any clear statement, what the Examiner regards as having been admitted by the applicant, still less what that alleged admission is relied upon to teach. As a result, no "clear issue" has been developed between the Examiner and the Applicant, and as noted in the MPEP 706 .07, a final rejection is in order only when such a clear issue has been developed.

2. Page 4 of the outstanding Office Action includes, at the end of a paragraph, the following statement.

The claims are also rejected employing Shimizu as the primary reference to teach both the shipping container containing sealed packages and the sealed package itself that have bananas passed their climacteric and wherein the packaging is permeable to the gases of respiration and wherein the packaging atmosphere includes exogenous ethylene and wherein the remainder of the art taken as a whole can be relied on as above to teach the manipulation of the well-known produce storage variables of weight, permeability etc.

There is no other reference to a rejection of the claims using Shimizu as the primary reference, still less a full statement of such a rejection, identifying the statutory ground of the rejection and any secondary references relied upon. It is again apparent that no clear issue has been developed between the Examiner and the Applicant.

3. As briefly noted above, the rejection based on Cummin as the primary reference relies on eight secondary references (as well as the unidentified "admission of prior art"). However, apart from the formal statement of the rejection,

(a) the disclosure of the primary reference, Cummin, is referred to just once, in a sentence which reads

> *In regard to claim 19 Cummin discloses that the applicant is not the first to store bananas in a sealed bag that is permeable to oxygen and carbon dioxide;*

(b) five of the secondary references (Badran, Scolaro, Badran et al. Anderson and Antoon) are referred to just once, in a sentence on page 2 which reads

> *As applicants admission of the prior art, Badran, Scolaro, Badran et al., De Moor, Anderson and Antoon attest to, the application of gas permeable packages and modified atmospheres to slow down ripening and increased storage life of produce, including bananas is notoriously old;*

(d) the other secondary reference, Herdeman, is referred to just once, in a sentence on page 3, which reads

> *It is noted that Herdeman further discloses reducing the oxygen upon initiation of ripening.*

The rejected claims (i.e. the claims before the amendments requested in the reply to the Office Action mailed 06/16/2006, which further limit those claims) included the following feature (as well as other features not listed below)

(1) the sealed polymeric bag containing the bananas has an oxygen permeability at 13°C per kg of bananas in the package (OP13/kg) of at least 700 ml//atm.24 hr.

The Office Action nowhere refers to this feature, or to a number of the features present in dependent claims, some of which are now included in the independent claims.

The Office Action frequently refers to "the art taken as a whole" in support of the rejection, the phrase "the art taken as a whole" in fact occurring about 12 times, and on page 4, the Office Action states

The rejection is based on what the art taken as a whole teaches...

it is believed to be clear that such a rejection does not comply with the statute.

As will be clear from the summary above, the Office Action does not explain why the references, either separately or in combination, disclose the various features of the claims, as is required by, for example, MPEP 2143.03 ("all the claim limitations must be taught or suggested by the prior art"). It is again apparent that no clear issue has been developed between the Examiner and the Applicant.

Amendments

Independent claim 19 has been amended to include the limitations of dependent claims 20, 28 and 31 (16-22 kg of bananas, OP13/kg of at least 1500 and EtOP13/kg at least 2 times the OP13/kg, and packaging atmosphere at less than 18°C. Independent claim 21 has been amended to include the limitations of dependent claim 33 (EtOP13/kg at least 2 times the OP13/kg). Consequential amendments have been made in the remaining claims. Claims 19 and 21 have also been amended to make it clear that the packaging atmosphere defined by the claims is a substantially constant

atmosphere. Claim 30 has been amended to make it clear that the bananas have passed the peak of their climacteric.

It is believed to be clear that, even if the finality of the Office Action is maintained, these amendments can properly be made at the present stage, since they limit the independent claims by features which were previously set out in dependent claims, or clarify the claims in response to comments made by the Examiner. Thus, these amendments do not raise new issues and put the claims in better condition for any appeal that may be necessary.

The Rejection under 35 U.S.C. 103

Applicants respectfully traverse the rejection of claims 19-24 and 27-37 under 35 U.S.C. 103 as unpatentable over U.S. Patent No. 3,798,333 (hereinafter "Cummin") in view of Applicant's admission of the prior art, further in view of U.S. Patent No. 5,658,607 (hereinafter "Herdeman"), further in view of U.S. Patent No. 3,450,542 (hereinafter "Badran 542"), EP 752378 (hereinafter "Scolaro"), U.S. Patent No. 3,450,544 (hereinafter "Badran 544"), U.S. Patent No. 6,013,293 (hereinafter "De Moor"), U.S. Patent No. 4,842,875 (hereinafter "Anderson"), U.S. Patent No. 5,045,331 (hereinafter "Antoon 331") and JP 57-94244 (hereinafter Shimizu), insofar as the rejection can be understood and insofar as it is applicable to the amended claims.

The "secondary reference" relied upon by the Examiner is "Applicant's admission of the prior art". The Examiner has not specified what that alleged admission is, or where such admission is to be found. It is not possible, therefore, to carry out, either with regard to the alleged admission on its own or in combination with the other references, the actions mandated by MPEP 2141, e.g. the so-called Graham inquiries, in order to determine whether the conditions set out in 35 USC 103 have been met. The rejection should be withdrawn for that reason alone. If the Examiner maintains any rejection which relies on an alleged admission by the Applicant, he is asked to specify

what that admission is and where it is to be found, so that further prosecution, by way of appeal or otherwise, can be conducted on a properly defined basis.

General

One of the comments made by the Examiner is that "Applicant has argued each reference separately as if they were applied alone in a vacuum". Applicant does not agree. In any event, the Examiner will no doubt agree that, as directed by MPEP 2141, the first step in determining whether claims are properly rejected under 35 USC 103 is to (A) determine the scope and content of the prior art, and (B) ascertain the differences between the prior art and the claims. The following comments are, therefore, made on each of the references relied upon by the Examiner.

Cummin

General Procedure in Cummin

Cummin discloses a procedure in which bananas

are packaged as soon after picking as is practicable in a film having a ratio of permeability of carbon dioxide to permeability of oxygen of at least three" (column 1, lines 59-62).

Preferably

the bananas are gassed with ethylene prior to packaging to trigger the ripening process so that all of the bananas will ripen at about the same predetermined time (column 2, lines 6-9).

In the preferred method (column 2, line 6-9 and 26-37) and in all the specific Examples, 3-5 green and ethylene-treated bananas are placed on a polystyrene tray and wrapped with a polymeric film having a thickness of 0.75 mil (0.000075 inch) and composed of polyvinyl chloride or an ethylene/vinyl acetate copolymer. No general directions are given for the temperature or time for which the bananas are stored in the sealed package, though the stated objective is storage for "prolonged periods" (column 2, lines 37-42). In the specific Examples, the packages were initially stored at 50°F (10°C) for

16 days. In Examples I-III, the films had oxygen permeabilities of 2700, 2100 and 1900 respectively, and good results were reported. In Example IV, the film had an oxygen permeability of 1350 and indifferent results were reported. In Example V, the film had an oxygen permeability of 150, and poor results were reported.

The Oxygen and Carbon Dioxide Levels in Cummin's Packages.

Cummin gives no general instruction as to the oxygen and carbon dioxide concentrations in the atmospheres within his packages. Cummin's specific Examples do give "average values" for the oxygen/carbon dioxide levels in the packages; they are 3.0/3.3 (Example I), 4.4/5.8 (Example II), 8.3/6.0 (Example III), 2.0/7.5 (Example IV) and 1.6/31.7 (Example V). Cummin does not explain how these "average values" were computed, and does not give any information about the oxygen and carbon dioxide contents at equilibrium.

The Wrapping Films Used by Cummin

Cummin's film has

a permeability to oxygen of at least 1000 ml. /100 in.^{2} 24hr atm at 23°C and a permeability to carbon dioxide of at least 3000, and a ratio of the permeabilities of carbon dioxide to oxygen of at least three

and,

from a practical consideration, the upper limits for oxygen permeability is about 6000 and the carbon dioxide permeability about 25,000

(column 2, lines 13-25, and 58-67).

In Cummin's specific Examples, films having a thickness of 0.75 mil had oxygen permeabilities of 150 to 2700. It is theoretically possible to increase the permeability of any film by reducing the thickness of the film or increasing its plasticizer content. However, one skilled in the art would know that these measures could not be used in practice to increase the oxygen permeability of the films used in Cummin's Examples. For example, even for the film having the greatest oxygen permeability (2700), the thickness would have to be reduced to about 0.3 mil to achieve the stated upper limit of

about 6000. A film of such thickness would present the most serious handling problems, even for a small package, and increasingly so as the size of the package increased. As for further increasing the plasticizer content, it has been recognized, since the date of Cummin, that plasticized films cannot be used safely for packaging foodstuffs of any kind.

According to column 5, line 7-13

> *the thickness of the film or sheet can be varied as desired, however, it has been found that a useful thickness for packaging bananas is between about 0.1 mil and 2 mils, preferably about 0.75 mil to 1.25 mils. Thickness greater than 2 mils may require additional plasticizer to attain the desired gas permeability rates.*

In all the specific Examples, the thickness of the film is 0.75 mil (0.00075 inch, 0.02 mm). To provide a better concept of such a film, it may be noted that the plastic wrap films extensively used in the kitchen (which are often made from the same polymeric materials as Cummin's wrapping sheets) have a thickness of about 0.004" (about 4 mil, 0.1 mm) or more, i.e. about twice the 2 mil upper limit of thickness suggested by Cummin, and about 5 times the thickness used by Cummin in all the specific Examples (see the attached Wikipedia entry for "plastic wrap").

Preferably

> *the ratio of the surface area of the film per weight of bananas is from about 100 in.^{2} to about 400 in.^{2} per kg of bananas", preferably from 130 to 250 in.^{2} per kg of bananas* (column 2, lines 32-36).

Thus, using 2-3 (typically 0.4-0.6 kg) bananas, as in Cummin's Examples, Cummin recommends wrapping film having an area of about 40 to about 240 in.^{2}, and in fact uses about 80 in.^{2} (this being the exposed area of the film wrapped around the polystyrene tray on which the bananas are placed). If 16 kg of bananas (the minimum in independent claim 19, and nowhere disclosed in Cummin) are to be used, Cummin recommended ratio requires a wrapping film having an area of 1600 to 5600 in^2. At the lower end of the recommended area, the wrapping film would have a total oxygen permeability at 23° C. of (i) 16,000 at Cummin's lower limit of 1000 for the oxygen

permeability of the wrapping film, (ii) 32,000 at Cummin's preferred lower limit of 2000, and (iii) 96,000 at Cummin's upper limit of 6000. Since permeability decreases sharply with temperature, these values would typically be reduced by about 50% at 13°C. The OP13/kg values of the resulting packages would, therefore, be (i) 500 at Cummin's lower limit of 1000, (ii) 1000 at Cummin's preferred lower limit of 2000, and (ii) 3000 at Cummin's upper limit of 6000. Using the most permeable film disclosed by Cummin in his Examples (in Example I, a PVC film having a thickness of 0.75 mil and an oxygen permeability at 23°C of 2700), the OP13/kg would be 1350. Theoretically, these OP13/kg values could be increased by increasing the area of the film, or decreasing the thickness of the film, or increasing the proportion of plasticizer. But none of these expedients can be used in practice, for the reasons explained below.

Increasing the Area

Even at Cummin's lower area limit of 1600 in.^{2} (for 16 kg of bananas) the physical properties of a wrapping film 0.75 mil thick (and composed of a polymer composition having a sufficiently high oxygen permeability) are such that the sheet cannot be used in practice. Such a sheet might for example be 32 x 50 inch. As the Examiner will no doubt know from his own experience, it is difficult enough to handle a sheet of conventional kitchen plastic wrap, more than five times the thickness of Cummin's sheets, and much smaller in size, for example 16 x 25 inch,. less than one quarter of the area of Cummin's sheets. Further increasing the size of the sheet would exacerbate the difficulties of handling the sheet

it should perhaps be noted that the dimensions of the large bags used by Applicant (38 x 50 inch) are similar to the exemplary 32 x 50 inch above. However, in Applicant's bags, the thickness of the sheet material is 0.056 mm (2.2 mil), i.e. about 3 times Cummin's thickness of 0.75 mil; and the bag is composed of polyethylene, which is much more easily handled than the PVC and ethylene/vinyl acetate materials used by Cummin, which are well-known for their clingy properties, which greatly decrease their handlability. This is well-known -- see for example the attached Wikipedia extract, which notes that "low density polyethylene (LDP) ... is less clingy than PVC... and does not contain traces of potentially toxic additives", and refers to the possible addition of

ethylene/vinyl acetate copolymers to polyethylene because the polymeric chains in ethylene/vinyl ester copolymers "readily interact with each other" thus making the polymeric composition more clingy, when that is the desired result.

Decreasing the Thickness

Decreasing the thickness of the wrapping sheet is not a viable option, because it makes the sheet still more difficult to handle.

Increasing the Proportion of Plasticizer.

As noted above, it is no longer regarded as safe to use plasticized materials of any kind for packaging foodstuffs.

Cummin's Films Cannot Be Used in the Form of Bags

The "clingy "characteristic of the PVC and ethylene/vinyl acetate copolymer materials which are used by Cummin make it very difficult to use them in the form of bags, since the two sides of a bag made from such materials stick firmly to each other, making the bag practically nusable. The Examiner will no doubt know from his own experience that once two flat sheets of kitchen plastic wrap have been brought into contact with each other, they cannot in practice be separated by any measure which could be used to separate the two sides of a bag.

Differences between Come in and claims 19 and 21

There are at least the following differences between claim 19 and Cummin.

(1) Cummin does not disclose a shipping or trucking container which contains a plurality of sealed packages (claim 19 only).

(2) Cummin does not disclose sealed packages which contain 16-22 kg of bananas (claim 19).

(3) Cummin does not disclose a sealed package which includes an atmosphere control member which comprises a microporous polymeric film and a polymeric coating on the microporous film (claims 19 and 21).

(4) Cummin does not disclose a sealed polymeric package having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg (claims 19 and 21.

(5) Cummin does not disclose a polymeric bag (claims 19 and 21).

(6) Cummin does not disclose a packaging atmosphere which is substantially constant and which comprises 1.5 to 6% oxygen, less than 15% carbon dioxide, the total quantity of oxygen and carbon dioxide being less than 16%, and exogenous ethylene or the residue of exogenous ethylene (claims 19 and 21).

Further Differences between Cummin and Dependent Claims

Claims 23 and 24 are further distinguished from Cummin by the requirement that the bananas in the packaging atmosphere are the sole contents of the sealed bag.

Herdeman

Herdeman discloses methods in which a modified atmosphere is injected into a container in which bananas are directly contacted by the modified atmosphere. The modified atmosphere must be "maintained within the container" (abstract, line 17 and column 4, line 31), and the volume within which the bananas are stored is preferably "substantially air-tight" (column 5, line 5).

Differences between Herdeman and claims 19 and 21

(1) Herdeman does not disclose a shipping or trucking container which contains a plurality of sealed packages (claim 19 only).

(2) Herdeman does not disclose a sealed bag which contain 16-22 kg of bananas (claim 19 only).

(3) Herdeman does not disclose a sealed bag which includes an atmosphere control member which comprises a microporous polymeric film and a polymeric coating on the microporous film (claims 19 and 21).

(4) Herdeman does not disclose a sealed polymeric bag having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg (claims 19 and 21).

(5) Herdeman does not disclose a polymeric bag (claims 19 and 21.

Badran 542

Badran 542 is concerned with the storage of pre-climacteric bananas in sealed polymeric bags at reduced temperature. Badran's objective is to ensure that

> *the internal gas contents of the bags, after an initial period, can attain equilibria in the range of, by volume, from about 1 to 5.5% oxygen and about 2.5 to about 7% carbon dioxide, with the carbon dioxide content higher than the oxygen content, which will be substantially maintained for a matter of up to about 28 days at a storage temperature between 53° and 70°F...* (column 3, lines 18-34).

All the bags used in the Examples of Badran 542 are composed of 150 gauge low density polyethylene (i.e. 0.0015 inch or 1.5 mil thick). The possibility of using other gas-impermeable polymeric films or higher gauge polyethylene is mentioned (column 7, lines 38-70). The oxygen permeability of the 150 gauge polyethylene is stated to be 1899 cc/100 in^2 .24 hr.atm at 0°C. **However, as a matter of fact, the oxygen permeability stated by Badran 542 is wrong.**

Attached hereto is a publication by ExxonMobil Chemical (hereinafter "Exxon"), which provides the oxygen permeabilities at 23°C for common polymer packaging films, including low density polyethylene (LDPE). Exxon states that a 1 mil thick LDPE film has an oxygen permeability at 23°C of 450-550 cc/100 in^2 .24 hr.atm, and that "you may

divide by the gauge in mil in order to approximate OTR at a different thickness". The Scolaro reference confirms these values. Thus, the oxygen permeability at 23°C of a 1.5 mil thick LDPE film (as used by Badran) is, according to Exxon, about 300-365 cc/100in² .24 hr.atm. Because oxygen permeability decreases as temperature decreases, a film having a permeability of 300-365 at 23°C. would have a much lower permeability at 0°C., for example about 150. It is, therefore, inconceivable that Badran's LDPE film should have an oxygen permeability of 1899 cc/100 in² .24 hr.atm at 0°C. It is very likely that, in preparing the Badran patent specification, the draftsman confused the non--metric and metric units of oxygen permeability. Thus, an oxygen permeability of 1899 in the standard metric units (ml/ m2.24hr.atm) would be equivalent to an oxygen permeability of 122 in the standard nonmetric units (cc/100 in² .24 hr.atm.).

Badran 542's error in the stated oxygen permeability of his LDPE bags is important in the present context because of its effect on the calculated OP13/kg value of his packages. For example, in Example I, each bag has a surface area of 1232 in.² and contains 9.1 kg of bananas. Using the **incorrect** value of 1899 cc/100 in² .24 hr.atm, the oxygen permeability at 0°C per kg of bananas is about 2570, and because permeability increases with temperature, the OP13/kg value would be substantially higher, for example about 4000. However, if the **correct** value, for example about 150, at 0°C is used, the OP13/kg is about 1/15 of that value, for example about 270. Similar calculations can be made for Badran 542's other Examples, and the more general expression in column 8, lines 5-8, that "in general the total square inch area of single thickness flexible gas-permeable film should be of the order of at least 1 in.² per 0.006-0.008 kg of bananas". Using the **incorrect** value of 1899 cc/100 in² .24 hr.atm, the quoted general expression implies an oxygen permeability at 0°C per kg of bananas of at least about 3165-4220, and a substantially higher OP13/kg value, for example at least about 4500-6500. Using the **correct** value, for example about 150, the OP13/kg value is about 1/15 of that value, for example at least about 300-435. It is of course possible to increase the OP13/kg value by reducing the thickness and/or increasing the area of the LDPE film, but the increase would have to be by a **factor** of at least 4 in order to reach the minimum of 1500 required by Applicant' s claims, and a change of such magnitude would be entirely impractical.

As noted below, the same error occurs in Badran 544.

Differences between Badran 542 and claims 19 and 21

(1) Badran does not disclose a sealed bag which includes an atmosphere control member which comprises a microporous polymeric film and a polymeric coating on the microporous film.

(2) Badran does not disclose a sealed polymeric bag having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg.

Scolaro

In Scolaro's method,

unripe (green) fruit are kept, at room temperature and for a certain period of time, in bags with given characteristics of permeability to gas and aqueous vapor, filled with a modified atmosphere (column 1, lines 53-57).

The modified atmosphere is injected into the bag in place of the air, and contains

oxygen in a quantity ranging from 2% to 20% by volume, preferably from 2% to 6% by volume, carbon dioxide in a quantity ranging from 0% to 20% by volume, preferably from 6 to 13% by volume, ethylene in a quantity ranging from 0% to 3% by volume, preferably from 0.1% to 1.5% by volume, the remainder being nitrogen (column 2, lines 46-53).

The resulting package

can be kept at room temperature for about 2,3 months, during which time, *the composition of the modified atmosphere remains substantially constant* (column 3, lines 17-20).

In Scolaro's only specific example, "one still unripe banana, or two or more bananas" are placed in a bag composed of low density polyethylene 35 micron (0.035 mm, 1.4 mil) thick and having a permeability to oxygen of 6800 cm^3/m^2 24hr atm, a permeability

to carbon dioxide of 22,000 cm^3/m^2 24hr atm, and a permeability to ethylene of 22,000 cm^3/m^2 24hr atm (column 2, lines 54-57); these permeabilities were measured by ASTM-D1434 (column 3, line 1), typically at 25°C. The modified atmosphere injected into the bag comprises 2% by volume of oxygen, 8% by volume of carbon dioxide, 0.1% of ethylene and 89.9% of nitrogen (column 3, lines 3-6).

There is no stated limit in Scolaro on the quantity of bananas or other fruit to be used. The only specific disclosure in Scolaro is for "one still unripe banana, or two or more bananas" in combination with a bag of 35 micron (0.035 mm, 1.4 mil) thick low density polyethylene film. A polyethylene film of such thickness is quite easily torn or punctured, and a bag made of such film becomes increasingly impractical as its size increases. As a result, a bag large enough to accommodate 16-22 kg of bananas is liable to be damaged. It may be noted that the bags used in the Examples of the present application are almost twice as thick (0.056 mm – see page 17, lines 10-18. It would of course be possible to use a bag of greater thickness, and therefore greater strength, in Scolaro's procedure (Scolaro mentions a range of 22 to 50 micron at column 2, lines 44-35), but this would proportionately decrease the oxygen permeability and OP13/kg, as discussed below.

The only specific container disclosed by Scolaro is made of low density polyethylene film 35 micron thick and having an oxygen permeability of 6800 cm^3/m^2 24hr atm at 25°C. As is demonstrated by the permeabilities for polyethylene films at 13°C and 22°C on page 17, lines 13-14 of this application, the oxygen permeability of polyethylene films at 13°C is which is lower than, e.g. about 60% of, the oxygen permeability at 22°C. The reduction will be somewhat greater in relation to a permeability measured at 25°C., as in Scolaro. Scolaro does not give any dimensions for the bags that he uses, but taking Scolaro's Figure (which is approximately life-size) as a guide, it appears that in his specific example, Scolaro used a bag about 11 x 19 cm. in size. Such a bag has a total surface area of about 0.042 m^2 (two surfaces each about 0.11 x 0.19 m) and (at the stated oxygen permeability of 6800 at 25°C) a total oxygen permeability at 25°C of about 285 cm^3 /24 hours. At 13°C, the total oxygen

permeability would be about 60% of this value, i.e. about 171 cm^3 /24 hours. For a single banana, typically weighing about 0.2 kg, the OP13/kg would be about 855; for two or three bananas, the OP13/kg would be proportionately reduced. For larger quantities of bananas, the bag would of course be larger, but for bags of the size appropriate for larger quantities, the reduction in the OP13/kg is still greater. As noted above, larger bags would also be likely to be made of thicker material, still further reducing the OP13/kg value.

Differences between Scolaro and claims 19 and 21.

There are at least the following differences between Scolaro and claims 19 and 21.

(1) Scolaro does not disclose a shipping or trucking container which contains a plurality of sealed packages (claim 19 only).

(2) Scolaro does not disclose sealed packages which contain 16-22 kg of bananas (claim 19 only).

(3) Scolaro does not disclose a sealed package which includes an atmosphere control member which comprises a microporous polymeric film and a polymeric coating on the microporous film (claims 19 and 21).

(4) Scolaro does not disclose a sealed polymeric package having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg (claims 19 and 21).

Badran 544

Badran 544 is concerned with the storage of climacteric foodstuffs, including ripe bananas, for which the recommended equilibrium atmosphere is 1.4-2.4%, of oxygen (claim 11). The foodstuffs are placed within a container comprising a gas-permeable polymeric film. Various films are listed in column 6, lines 1-11, but low density polyethylene (LDPE) films are preferred because the other films "do not generally have

as high oxygen diffusion rates as LDPE". Figure 3 shows the oxygen and carbon dioxide permeabilities at 0°C of LDPE films of different gauges. **However, as in Badran 542, the values given are wrong, the numerical values apparently being correct for metric values (per square meter), but wrong for nonmetric values (per 100 in.^{2})**. Column 5, lines 31-34 states that the area of the polymeric film should be at least 1 in.^{2} for each 0.003-0 .008 kg of foodstuff (at least about 125-330 square inch per kg of foodstuff). In the only specific Example concerned with bananas, about 1 kg of bananas was placed in LDPE bags of 50 to 75 gauge and a size such that its internal surface area was 1 in.^{2} per 0.008 kg of bananas (125 in.^{2}).

In Badran 544's specific example, using Badran 544's **incorrect** values for oxygen permeability, the highest total oxygen permeability (achieved when using 50 gauge LDPE film) is about 7375 (125 x 56.96), which corresponds to a somewhat higher OP13/kg value, for example about 10,000. However, using the **correct** values the OP 13/kg value drops to about 1/15 of the wrongly calculated value, for example about 670. Similar calculations can be made for the more general expression in column 5, lines 31-34, that the film area should be at least 1 in.^{2} per 0.003-0.008 kg of bananas". Using the **incorrect** value of 5696 cc/100 in^2 .24 hr.atm for a 50 gauge LDPE film at 0°C, the quoted general expression implies an oxygen permeability at 0°C per kg of bananas of at least about 3165-4220, and a substantially higher OP13/kg value, for example at least about 4500-6500. Using the **correct** value, for example about 150, the OP13/kg value is about 1/15 of that value, for example at least about 300-435. It is possible to increase the OP13/kg value by reducing the thickness and/or increasing the area of the LDPE film, but the increase in the area or decrease in thickness would have to be by a **factor** of at least 4 in order to reach the minimum of 1500 required by Applicant's claims. Such an increase (or decrease) would be entirely impractical.

Differences between Badran 544 and claims 19 and 20

There are at least the following differences between Badran 544 and claims 19 and 21.

(1) Badran 544 does not disclose a shipping or trucking container which contains a plurality of sealed packages (claim 19 only).

(2) Badran 544 does not disclose sealed packages which contain 16-22 kg of bananas (claim 19 only).

(3) Badran 544 does not disclose a sealed package which includes an atmosphere control member which comprises a microporous polymeric film and a polymeric coating on the microporous film (claims 19 and 21).

(4) Badran 544 does not disclose a sealed polymeric package having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg (claims 19 and 21).

(5) Badran 544 does not disclose a sealed container in which the atmosphere contains exogenous ethylene or the residue of exogenous ethylene.

De Moor

De Moor discloses a particular type of atmosphere control member. De Moor does not refer to bananas of any kind. Insofar as De Moor is of any relevance, which Applicant denies, the O_2 contents disclosed therein are 1-2% (column 1, line 49, for broccoli) and 5-8% (column 1, line 53, for cherries).

Differences between De Moor and claims 19 and 21

There are at least the following differences between De Moor and claims 19 and 21.

(1) De Moor does not disclose any package containing bananas (claims 19 and 21)

(2) De Moor does not disclose a shipping or trucking container which contains a plurality of sealed packages (claim 19 only).

(3) De Moor does not disclose a sealed polymeric package having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg.

(4) De Moor does not disclose a sealed bag in which the atmosphere contains exogenous ethylene or the residue of exogenous ethylene.

Anderson.

Anderson relates to the "controlled atmosphere storage of fresh fruits and vegetables" including "items, such as ... bananas... routinely picked in a less-than-ripe condition and stored at reduced temperatures" (column 1, lines 10-28). Anderson's invention is to make use of a container which is substantially gas-impermeable except for a panel of a microporous plastic membrane which is "a biaxially oriented film" as specified in column 2, lines 38-53. The panel produces "a flux of O_2 approximately equal to the predicted O_2 respiration rate for not more than 3.0 kg of the enclosed fruit..." (column 2 lines 48-53, and claim 1). Table 1, column 3, states that, for "bananas, ripening", the O_2 respiration rate at 21°C is 44 cc of oxygen/kg.hr, i.e. 1056 (44 x 24) ml of oxygen/kg.24hr. Therefore, for a package containing 3.0 kg of bananas, the total respiration rate at 21°C will be 3168 ml of oxygen/kg.24hr. Table 3 also states that, for "bananas, ripening", the desired atmosphere is 2-5% O_2 and 2-5% CO_2.

It is not entirely clear whether Anderson is concerned only with packages containing less than 3.0 kg of fruits, or whether Anderson's teaching is that if the package contains more than 3.0 kg of fruits, the oxygen flux should be limited to that which is appropriate for 3.0 kg of fruits. Whatever Anderson may mean in this regard, it is clear that Anderson either does not disclose packages containing more than 3.0 kg of fruits, or teaches that, for a container containing more than 3 kg of bananas, for example 16 to 22 kg of bananas, as in claim 19, the respiration rate should not exceed the rate required for 3.0 kg of bananas. As explained above, the rate required for 3 kg of bananas, is 3168 ml of oxygen/24hr. at 21°C. A container that has a permeability at

21°C of 3168 ml of oxygen/24hr. will have a substantially lower permeability at 13°C, for example about 2000 ml of oxygen/24hr. , i.e. an OP13/kg value of, for example, about 670. For packages containing greater quantities of bananas, the OP13/kg value will progressively decrease.

Differences between Anderson and claims 19 and 21

There are at least the following differences between Anderson and claims 19 and 21.

(1) Anderson does not disclose a shipping or trucking container which contains a plurality of sealed packages (claim 19 only).

(2) Anderson does not disclose sealed packages which contain 16-22 kg of bananas (claim 19 only).

(3) Anderson does not disclose a sealed bag which includes an atmosphere control member which comprises a microporous polymeric film and a polymeric coating on the microporous film (Anderson's atmosphere control member consists of a microporous film) (claims 19 and 21).

(4) Anderson does not disclose a sealed polymeric package having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg (claims 19 and 21).

(5) Anderson does not disclose a packaging atmosphere which contains exogenous ethylene or the residue of exogenous ethylene (claims 19 and 21).

Antoon 331

Antoon 331 is very similar to Anderson, except that the panel controlling the flux of the container is composed of a nonwoven material coated with a water resistant resin. As in Anderson, Table 1, column 3, states that, for "bananas, ripening", the O_2 respiration rate is 44 cc of oxygen/kg.hr, i.e. 1056 (44 x 24) ml of oxygen/kg.24hr. For a package containing 3.0 kg of bananas, therefore, the total respiration rate will be 3168

(1056 x 3) ml of oxygen/kg.24hr. Table 3 also states that, for "bananas, ripening", the desired atmosphere is 2-5% O_2 and 2-5% CO_2.

Differences between Antoon 331 and claims 19 and 21

There are at least the following differences between Antoon 331 and claims 19 and 21.

(1) Antoon 331 does not disclose a shipping or trucking container which contains a plurality of sealed packages (claim 19 only).

(2) Antoon 331 does not disclose sealed packages which contain 16-22 kg of bananas (claim 19 only).

(3) Antoon 331 does not disclose a sealed bag which includes an atmosphere control member which comprises a microporous polymeric film and a polymeric coating on the microporous film (Antoon 331's atmosphere control member is composed of a non-woven material and a polymeric coating on the non-woven material) (claims 19 and 21).

(4) Antoon 331 does not disclose a sealed polymeric package having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg (claims 19 and 21).

(5) Anderson does not disclose a packaging atmosphere which contains exogenous ethylene or the residue of exogenous ethylene (claims 19 and 21).

Shimizu

Shimizu relates the storage of fruits, e.g. bananas, in a container, a warehouse or a truck. The bananas are placed in an airtight enclosure with an adsorbent having ethylene gas absorbed thereon.

Differences between Shimizu and claims 19 and 21

There are at least the following differences between Shimizu and claims 19 and 21.

(1) Shimizu does not disclose a shipping or trucking container which contains a plurality of sealed packages (claim 19 only).

(2) Shimizu does not disclose sealed packages which contain 16-22 kg of bananas (claim 19 only).

(3) Shimizu does not disclose a sealed bag which includes an atmosphere control member which comprises a microporous polymeric film and a polymeric coating on the microporous film (claims 19 and 21).

(4) Shimizu does not disclose a sealed polymeric bag having an oxygen permeability at 13°C per kg of bananas (OP13/kg) of at least 1500 ml/atm.24hr and an ethylene permeability of 13°C per kg of bananas (EtP/kg) which is at least 3 times OP13/kg (claims 19 and 21).

Further Differences between Shimizu and Dependent Claims

Claims 23 and 24 are further distinguished from Shimizu by the requirement that the bananas and the packaging atmosphere are the sole contents of the sealed bag.

The Combination of the References

Having regard to the differences noted above between the claimed invention and the references, viewed individually, the burden is on the Examiner to demonstrate that the references, considered together, teach or suggest all the claim limitations, and do so with a reasonable expectation of success (MPEP 2143).

As noted above in the section entitled Request to Remove the Finality of the Office Action, the rationale advanced by the Examiner is supported principally by assertions based on "the art taken as a whole", and not by identified by reference to disclosure in the references. The Examiner's assertions are apparently based on the

Examiner's own understanding and experience. However, as MPEP 2144.03 notes, quoting from Zurko, 59 USPQ 2d at 1697

> "The Board cannot simply reach conclusions based on its own understanding or experience – or on its assessment of what would be basic knowledge or common sense. Rather, the Board must point to some concrete evidence in the record in support of these findings".

The Examiner, who is of course under the same obligations as the Board, has not pointed to any such concrete evidence.

Applicant submits that, in view of the facts and arguments set out above, the Examiner has failed to establish a prima facie case for the rejection of the claims under 35 USC 103.

Patentability of claims dependent on claims 19 and 21

It is clear that if claims 19 and 21 are patentable, as Applicant submits, so also are the claims dependent on them, which are of more restricted scope. However, for the sake of completeness, Applicant notes that claims 23 and 24 require that the bananas and the packaging atmosphere are the sole contents of the sealed polymeric bag. This feature further distinguishes these claims from the references, and is relied upon for the independent patentability of the claims in question. Thus,

(1) Shimizu requires that an adsorbent, e.g. a zeolite, on which ethylene is adsorbed, should be placed within the container before it is sealed around the bananas (or other vegetable or fruit).

(2) Cummin requires the use of a support tray within the sealed container, because the extremely thin films used by Cummin cannot practically be used in the form of preformed bags, and must be wrapped around the bananas while the bananas are supported by a support tray.

Request to Return Signed Information Disclosure Statements

Applicant mailed Information Disclosure Statements on 4/26/2002, 5/20/2002, 1/8/2003, and 5/13/2003. The documents listed in those Information Disclosure Statements were supplied to the Office in the parent application No. 09/858,190. The Examiner is asked to sign and return the Information Disclosure Statements

CONCLUSION

It is believed that this application is now in condition for allowance, and applicant respectfully requests that a timely Notice of Allowance be issued in this case. If, however, there are any outstanding issues that could usefully be discussed by telephone, the Examiner is asked to call the undersigned.

Respectfully submitted

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ExxonMobil
Chemical

OTR

ExxonMobil # 475, 476, 478
ASTM D 3985

Definition

OTR (oxygen transmission rate) is the steady state rate at which oxygen gas permeates through a film at specified conditions of temperature and relative humidity. Value are expressed in cc/100 in²/24 hr in US standard units and cc/m²/24 hr in metric (or SI) units. Standard test conditions are 73°F (23°C) and 0% RH.

Relevance to package performance

The air we breathe is about 21% oxygen and 79% nitrogen, with very small concentrations of other gases like carbon dioxide and argon. Essential to human and animal life, oxygen gas is also a reactive compound that is a key player in food spoilage. Most of the chemical and biological reactions that create rancid oils, molds, and flavor changes require oxygen in order to occur. So, it is not surprising that food packaging (and some non-food packaging for products where atmospheric oxygen causes harm) has progressed and found ways to reduce oxygen exposure and extend the shelf life of oxygen-sensitive products.

There are two methods for reducing product exposure to oxygen via flexible packaging.

1. *MAP (modified atmosphere packaging)* is a process for replacing the air in the headspace of a package with another gas before the final seal is made. This is also called gas flushing. The most common replacement gases are nitrogen or nitrogen/carbon dioxide mixtures. The shelf lives of potato chips, dried fruits, nuts, and shredded cheese are commonly extended by this packaging method.
2. *Vacuum packaging* is where the atmosphere is drawn out and eliminated, rather than being replaced by another gas. This vacuum forces the flexible material to conform to the product shape. Meats (fresh and processed) and cheeses are commonly packaged this way.

Once air has been replaced or eliminated from the package, there must be an adequate oxygen barrier and seal integrity to keep a low oxygen concentration inside the pack. Otherwise, the driving force created by the oxygen partial pressure differences (21% outside the bag and 0-2% inside the bag) will cause an ingress of oxygen and destroy the benefit of removing it in the first place. OTR values are used to compare the relative oxygen barrier capabilities of packaging films. An industry rule-of-thumb is that a material is considered a "high oxygen barrier" if its OTR is less than 1 cc/100 in²/24 hr (15.5 cc/m²/24 hr).

Table 1 shows OTR values for common polymer packaging films. Note that the table is divided into two sections. The first contains normalized (1 mil) values for common materials. The second section displays the OTRs for coated or metallized films where the total film thickness is unimportant, because the barrier is primarily coming from the additional layer.

ExxonMobil Chemical Company • 729 Pittsford-Palmyra Road • Macedon • NY • 14502 • USA

Film Type	OTR @ 73°F (23°C), 0% RH (cc·mil/100 in²/24 hr)	(cc/m²/24 hr)
The following OTRs are bulk material properties displayed at 1 mil. You may divide by the gauge (in mil) in order to approximate OTR at a different thickness.		
EVOH* (ethylene vinyl alcohol)	.005 - .12	.08 - 1.9
Biax Nylon-6	1.2 - 2.5	18.6 - 39
OPET (oriented polyester)	2 - 6	31 - 93
OPP	100 - 160	1550 - 2500
Cast PP	150 - 200	2300 - 3100
HDPE (high density polyethylene)	150 - 200	2300 - 3100
OPS (oriented polystyrene)	280 - 400	4350 - 6200
LDPE (low density polyethylene)	450 - 550	7000 - 8500
The following OTRs are enhanced by coating or metallizing. Therefore, these are not bulk film properties, and total film thickness has little impact on the OTR value.		
Metallized OPET	.01 - .11	.16 - 1.7
PVOH-coated OPP (AOH)	.02	.31
Metallized biax Nylon-6	.05	.78
PVdC-coated OPET	.30 - .50	4.7 - 7.8
High Barrier PVdC-coated OPP	.30 - .60	4.7 - 9.3
PVdC-coated biax Nylon-6	.35 - .50	5.4 - 7.8
Metallized OPP	1.2 - 10	19 - 160
Sealable PVdC-coated OPP	1.5 - 3.5	23 - 54

Table 1: OTR values for common films

* The range of possible values is especially wide for EVOH because the value is dependent on the ethylene content of the particular grade. EVOH is typically a buried layer, either via coextrusion or lamination.

CAUTION: In order for film oxygen barrier to contribute its full product protection value, package seal integrity must be satisfactory. Poor quality seals can negate a film's good barrier by allowing oxygen transmission through channel leakers and imperfections.

Related information: Many customers ask about the carbon dioxide (CO_2) and nitrogen (N_2) transmission rates through film. ExxonMobil does not perform [illegible] testing with these gases, but a value range can be estimated from OTR values by using the following relationships:

CO_2TR will be 3 to 5 times the OTR value at 73°F (23°C), 0% RH

N_2TR will be [illegible] times the OTR value at 73°F (23°C), 0% RH

For example, the OTR of 110 AXT is [illegible] cc/100 in²/24 hr @ 73°F (23°C) 0% RH. Therefore, at the same conditions, the CO_2TR is approximately [illegible] cc/100 in²/24 hr and N_2TR is approximately [illegible] cc/100 in²/24 hr.

What affects the OTR of films

Good oxygen barrier is achieved by combining functional layers to create a film with the required barrier, as well as those other properties necessary to produce a serviceable package. For example, EVOH has exceptional OTR properties, but needs moisture barrier and mechanical properties provided by layers that are coextruded or laminated around it.

OTR is most affected by the following factors.

1. *Thickness of barrier layer:* Generally, the thicker the oxygen barrier-providing layer, the better the barrier. But there are process and cost limitations that restrict the thicknesses that can be realistically produced or successfully utilized.
2. *Copolymer ratio, plasticizer content, and polymerization process:* All PVdCs (or EVOHs or PVOHs) are not created equal. Properties are compromised during polymer and product development, so that total performance in target applications is optimized. There can be substantial differences in OTR values depending on the selections made. For example, both ASB-X and AXT are PVdC-coated and sealable, but their OTRs are 4.5 cc/100 in²/24 hr and .40 cc/100 in²/24 hr, respectively. ASB-X has the poorer OTR, but a broader seal range than AXT.
3. *Base film surface compatibility:* The physical and chemical characteristics of the base film surface have a major effect on the OTR after metallization, and to a lesser degree, after coating. This is evidenced by Met PET's exceptional barrier, as well as the difference in OTRs between various metallized OPP products (refer to Table 1).

ExxonMobil only measures and controls OTR for those films that are modified through coating, coextrusion, or metallization, and guarantee a maximum OTR value in the product specification. This includes AXT, HBS-2, AOH, MET-HB, and MU842.

Test principles

ExxonMobil uses MOCON OX-TRAN® instruments for measuring OTR. The instrument design and the way we operate the instrument are consistent with the ASTM D 3985 standard. ExxonMobil standardizes its reporting to test conditions of 73°F (23°C) and 0% RH.

Conceptually, a test cell looks like Figure 1. Dry nitrogen gas is swept through a chamber, where the test film acts as the membrane separating this stream from an oxygen stream on the other side. The partial pressure difference creates a driving force for oxygen molecules to diffuse through the film to the low pressure side. The film barrier determines the rate of oxygen permeation, and this is continuously measured by a MOCON® patented coulometric sensor in the outgoing stream of the nitrogen side.

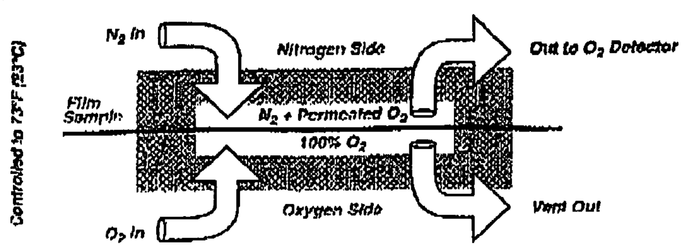


Figure 1: Cross-section of an OTR test cell

The test is complete when equilibrium, or steady state, is achieved; that is, it is complete when the sensor detects a constant amount of oxygen in the nitrogen carrier stream. The rate of oxygen permeating through the sample is not changing. This rate is the sample OTR and is recorded in units of cc/100 in²/24 hr or cc/m²/24 hr at 73°F (23°C), 0% RH.

This discussion is an overview of how ExxonMobil measures OTR and was based on articles and product literature provided by MOCON®. There is much more substance to the science and measurement of mass transfer. For more information, contact MOCON® in Minneapolis, MN at (612) 493-6370, or visit www.mocon.com.

NOTE: *It is important to discuss the effects of relative humidity on OTR, even though the ASTM standard procedure is at dry conditions. Relative humidity has a dramatic and negative effect on the OTRs of some materials, most notably nylon, EVOH and PVOH. The effect is especially pronounced at RHs over about 70%. AOH, with its PVOH coating, is the only ExxonMobil oxygen-barrier film affected this way. AOH should only be used as an oxygen barrier in dry applications. Consult your ExxonMobil representative.*

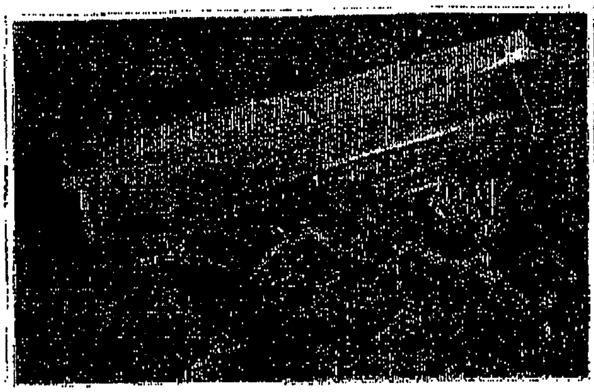
Related terminology

PVdC	PVdC stands for polyvinylidene chloride, but The Dow Chemical Company points out in the 2nd edition of The Wiley Encyclopedia of Packaging Technology that the use of this term is not precisely correct. PVdC suggests a homopolymer resin; when in fact, all commercial resins are VdC copolymers and should be referred to as such. Nevertheless, it is not likely that our industry will change its ways, where "PVdC" has become a generally accepted representation for the family of VdC copolymers.
Saran®	Saran® is a trademark of The Dow Chemical Company for its family of PVdC and VdC copolymer products.
Oxygen scavengers	Oxygen scavengers are materials that chemically react with oxygen in a package headspace. They can be used with MAP in order to attain very low oxygen concentrations (ppm levels) that are not achievable with MAP alone. Most oxygen scavengers used commercially are packets containing iron powders that are placed inside a package and consume headspace oxygen through oxidation reactions.

Plastic wrap

From Wikipedia, the free encyclopedia

Plastic wrap, known as *cling-film* in the United Kingdom, is a thin polymer material, roughly 0.004" to 0.006" (0.11 to 0.15mm) thick, typically used for sealing food items in containers to keep them fresh. The wrap, typically sold on rolls in boxes with a cutting edge, clings to many smooth surfaces and can thus remain tight over the opening of a container with no adhesive or other devices.



A roll of LDPE plastic wrap in a box. The lid of the box has a serrated edge for cutting the film.

Commonly known brands of plastic wrap, in the United States, include Saran wrap and Stretch-Tite. In Australia and New Zealand, **Glad wrap** is the leading brand, known well enough to make its manufacturer concerned about its trademark becoming genericized.[1] (http://www.findarticles.com/p/articles/mi_hb226/is_200310/ai_hibm1G1110462360) In Hong Kong, a company named Fine Vantage Limited is the major private label LDPE plastic wrap manufacturer.

A similar material can also be made at home by spreading clear glue on a smooth flat surface and allowing it to dry. Depending on the thickness of the layer of glue, it may tear easily, or it may be tougher and more difficult to stretch.

Contents

Characteristics

An ideal plastic wrap should meet the following user expectations. Some testing labs, such as SGS, can offer plastic wrap testing to certify it is suitable for food contact and has the right tensile strength.

- Easy to pull out of the box and easily separated by the cutter.
- Cling well with glass, ceramics and stainless steel, but will not cling to itself.
- Close to total transparency with no haze, film wrinkles, tension marks, un-even thickness, or gel.
- High tensile strength so that the film will not easily break apart. This is difficult to achieve, as plastic wrap is only 11 to 15 microns thick.
- Packaged in a food-grade paper box printed with soy ink. Historically, about 30% of imported food-related products are fined by the customs officer because of failing to meet packgaging requirements.

Materials used

Plastic wrap was first made from PVC, which remains the most common material, but non-PVC alternatives are

now being sold because of concerns about the transfer of plasticizers from PVC into food. It is also problematic to achieve full polymerization of the material, which can contain remains of vinyl chloride. For food catering applications, PVC is the most common. For household use, LDPE is gaining market share because it is purportedly safer.

More and more countries over the world are concerned about the environmental impact of PVC, as the material is toxic and is hard to recycle. PVC is still used because its stretching properties offer excellent food catering presentation on the shelf, and it clings well to more kinds of surfaces. Some countries are starting to ban the use of PVC in toys for infants and food contact applications.

Saran Wrap is made of polyvinylidene chloride (PVdC).

The PVC-based films contain plasticizers, most often bis(2-ethylhexyl) adipate (DEHA), but phthalates (most often dibutyl phthalate (DBP) and bis(2-ethylhexyl) phthalate (DEHP) also cause concern. The plasticizers were found to migrate to some foods, for example cheeses or fatty fish and meat. In the UK, polymerized plasticizers replaced DEHP in this application, largely eliminating the problem. [2] (http://www.mindfully.org/Plastic/EDs-Plastic-Wraps-CU5jun98.htm)

A common alternative to PVC is low density polyethylene (LDPE), which is less clingy than PVC, but also does not contain traces of potentially toxic additives. Newer production processes are closing the clingy gap between PVC and LDPE. Linear low density polyethylene (LLDPE) is sometimes added to the material, as it increases the clinginess and the tensile strength of the film. [3] (http://www.darrenbarefoot.com/archives/2005/10/cling-wrap-explained.html) Brands like Glad Cling Wrap or Handi-Wrap are LDPE-based. Saran Premium Wrap, a newer version of Saran Wrap, is based on LDPE as well.

Glad Press'n Seal has its surface covered by microscopic spikes, preventing direct contact of the polymer surfaces, preventing it from sticking to other materials, including itself. To achieve the adhesion, the material has to be subjected to mechanical force, crushing the spikes.

PVdC has better barrier properties than the more-permeable LDPE, but LDPE is substantially cheaper to make.

LDPE nor PVdC are insufficiently clingy on their own, and they do not adhere to themselves. To achieve the desired clinginess, certain polymers with lower molecular weight have to be added; the most common two are polyisobutene (PIB), and poly[ethylene-vinylacetate] (EVA) copolymer. Their chains readily interact with each other and their lower molecular weight makes them more mobile within the host polymer matrix. [4] (http://www.madsci.org/posts/archives/mar98/890527087.Ph.r.html)

See also

- Wax paper
- Aluminium foil

External links

- The History of PVDC from About.com (http://inventors.about.com/library/inventors/blsaranwrap.htm)

Reference

- "Cling film - a revolution in the food industry", European Council for Plasticisers and Intermediates (http://www.ecpi.org/upload/documents/document8.doc) (MS Word document).

Categories: Plastics applications | Packaging materials | Food utensils